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Water Management Functions/ Objectives

In what follows, we define "water system" to mean all the factors that define how water is managed -- infrastructure, regulations, laws, contracts, and operating rules.

Reduce Diversion Conflicts

The existing water system pits water users against environmental interests. If water diversions are increased to support increased economic activity, the environment suffers. If diversions are reduced to enhance environmental conditions, the economy suffers. California's water problems will not be solved until water users can meet their water needs without causing new environmental damage and environmental interests can generate environmental enhancement without hindering economic activity.

A tool reduces diversion conflicts if it tends to decouple economic health from environmental harm, and environmental health from economic harm.

Increase Supply Predictability

The economic value of water is related to the predictability of water deliveries. The farther into the future that water supplies can be predicted by individual users, the greater the economic investments that can be justified by the user. Conversely, if available supplies are unpredictable, then economic harm will result. For example, if water supplies are during the growing season are either higher or lower than predicted, then farmers will have planted either too few or too many acres. The hydrological cycle is unpredictable on an annual basis. Take restrictions under the ESA cause additional unpredictability. A variety of methods exist which can increase supply predictability **[Note to reviewers: the tools will include storage, screens, markets, changed intake locations, plus the ERP as a whole which might allow ESA restrictions to be lifted]**

A tool increases supply predictability if it tends to increase the accuracy of intra year supply projections compared to the current water system.

Increase Supply Utility

Higher quality water is worth more than lower quality water to users. Southern California, water which is too salty cannot be recycled and must be discharged into the ocean. Colorado River water is very salty to begin with. Delta water is used to dilute Colorado River water and to allow the composite to be used more than once. The less salt in water from the Delta, the more times the water may be recycled. For agriculture, the saltier the water the more water is required for leaching and the greater the amount of water that is carried either into the groundwater or into the San Joaquin River (where it causes salinity problems for Delta farmers and may be reexported).

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A tool increases supply utility if it increases the value/acre-foot of water to users.

Improve Drinking Water Quality

A major objective of water management is to provide urban areas with raw water that can be treated to healthy levels at a reasonable cost. Water is healthy if it meets all applicable water quality standards. However, in general, water agencies wish to provide water which is of higher quality than required by law. The problem can and should be attacked at both ends; (1) the quality of the raw water provided to urban agencies can be improved; and (2) it may be possible to implement more effective treatment processes.

A tool increases drinking water quality if it improves the quality of raw water provided to urban agencies or if it improves the effectiveness of water treatment.

[This section opens to door to discussion of the following tools: source control, infrastructure (e.g., storage), operational shifts, increased outflow, and improved treatment]

Decrease Drought Impacts

During droughts, the runoff falls below normal. Therefore, total water use (including both environmental and economic uses) must drop except to the extent that supplies are bolstered by stored water. During the 1987 - 1993 drought, both the economy and the environment suffered harm from these shortages. A variety of tools are available to ameliorate these impacts. In general, however, either the environment and/or water users must become less sensitive to water shortages or more water in storage must be made available for environmental and economic purposes. Both approaches have potential. **[Note to reviewers. Environmental insensitivity to shortage is promoted by habitat improvements that allow fish to find good habitat even if X2 moves upstream. User insensitivity to shortage is promoted by water markets -- users either get water, or are reimbursed for going without water. Note that demand hardening (to the extent it exists) would push us in the other direction.]**

A tool decreases drought impacts if it either reduces overall system shortages (i.e., increases overall water supplies during drought) or reduces the overall environmental and economic impacts of shortages.

Increase Supply Availability

Water is the foundation of the California economy. Increases in the effective amount of water available to the economy will allow for greater levels of economic activity. Water is the foundation of the Bay-Delta ecosystem. Increases in the amount of water flowing through the natural system at the right times and places will lead to improvements in environmental conditions. Note that, with the relatively minor exceptions of desalting and perhaps cloud seeding, we cannot increase overall water supplies. The amount of water in the system is largely fixed by the weather. Rather, the challenge is the increase the availability of water at the right times and places to meet economic and environmental needs. Numerous tools exist which can assist in achieving this goal.

A tool increases supply availability if it allows the environment or individual water users to acquire additional water at high priority times and places.

[Note that this section overlaps heavily with the "decrease drought impacts" section just above. For this reason, I have focussed on overall water supply in this section, leaving drought water supplies to be discussed there. Note also that I would propose to define water supply availability so as to include improvements through conservation, recycling, and water markets in addition to classical water development. Water markets in particular are a little odd in this category, since they do not increase overall supply, but are a compensated shift in demand. But I don't see where else we could put long-term water transfers than in this section. Thus, I would probably recommend that we retitle this category to something like: "increase the ability to individual users to secure increased supplies"]

Increase Operational Flexibility

[I view increased operational flexibility as a tool, not a goal. It is directly related to storage, diversion management, and the creation of multiple diversion points. The use of the tool will tend to reduce conflicts, increase predictability, and increase supply availability.]

Water Management Tools

Conservation

Conservation is any technique whereby economic output can be maintained with less water. In the long run, conservation savings are only meaningful at the state level if the water saved would otherwise be unusable by other water users. During some periods, however, (e.g., droughts), conservation can provide benefits by reducing immediate demand on the stressed surface water system.

Agricultural

Agricultural conservation can result from both management and technical improvements

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at both the district and farm level. Long-term conservation is particularly valuable in areas with salty groundwater, toxic runoff, or perched water tables. Short term conservation is valuable in all areas.

Urban

Most major California urban areas discharge into the Pacific Ocean. Therefore, unless water recycling consumes a large fraction of waste water, water conservation will reduce demand for water. Conservation in the Central Valley also reduces demand for water and may reduce infrastructure needs. However, waste water in the Central Valley returns to the water system and can be reused downstream. As with agriculture, short term conservation will frequently be valuable in reducing demands on scarce surface water.

Wetlands

Different management and different techniques are required, but effectively the same as agricultural efficiency.

Cropping Patterns

Cropping shifts can take place without any improvement in management or technology, therefore we distinguish them from conservation. However, the result may be the same -- similar economic outputs using less water. Since the savings result from reductions in ET, cropping shifts provide both short and long-term benefits. Cropping shifts might occur as a result of changed economic conditions (e.g., incentive programs, or a high market value for water

Reuse

Distinguished from conservation in that it does not involve improvements in the management or technology of water use, but involves reusing water unused during a previous application. Urban areas have a very high potential for reuse, though the cost can be quite high.

Storage

Storage is a device for separating the timing of water diversion from the timing of water use. Without storage, environmental and economic needs can only be met using the water that happens to be flowing in the rivers at any given time. Storage is an extremely important tool in California, where runoff is highly variable by season and by year. Historically, storage has been used to hold water running off during the winter and spring for the agricultural growing season in the summer. Similarly, water diverted in wet years has been held over for future dry years. More recently, water stored in the winter months has been held in storage to allow for reduced diversions in the spring when the diversions would be harmful to fish. Finally, CALFED is studying the possibility of real-time management of diversions. With real-time management, diversion timing and volume would be partially governed by biological conditions near the diversion point. Real-time management will introduce a spikeyness to diversion patterns that can only be smoothed out using storage. Storage could also be used to increase instream flows during key periods.

Different types of storage have characteristic strengths and weaknesses. The most versatile type of storage is onstream surface storage. The storage can fill as fast as water runs into the reservoir and can discharge water at high rates. However, onstream storage causes severe environmental damage and is highly controversial. Expansion of existing onstream surface storage is less problematic.

Offstream surface storage is less versatile. Reservoir fill rates are limited by intake and pumping capacities. Discharge rates are limited by engineered capacity constraints. Diversions to storage may entrain fish of concern to CALFED.

Groundwater storage is the least versatile type of storage. Fill rates are constrained by the size of distribution systems and by the rate at which water can be introduced into the ground. Extraction rates are limited by the rate at which water can be pumped from the ground. Diversion to groundwater storage may cause entrainment of concern to CALFED.

These different characteristics imply that different storage types should be operated in an integrated fashion to maximize the benefits of different types of storage. Onstream and offstream surface storage should be used to buffer rapid changes in flow and diversion regimes. Offstream and groundwater storage should be used to buffer multi year shortages.

There is an implicit need for conveyance capacity sufficient to service any proposed storage. For surface water, this may be obvious -- a canal must connect the reservoir to the river. Groundwater storage has similar needs, but the problem of distribution may be more complex since water must be delivered to large areas of land to generate reasonable fill and extraction rates.

Increased Flood Flow Capacity

Floodways or other measures which increase the ability to pass flood flows below reservoirs may allow for reduced flood control reservations in the upstream reservoirs. Reduced flood control reservations translate into higher carryover storage in reservoirs and increases in water supplies, particularly going into dry years.

Watershed Management

Before water which falls in the mountains surrounding the Central Valley reaches the valley, it must flow down the mountains and through the reservoirs that ring the Valley. Actions in the upstream watersheds can have an impact on the patterns of runoff and upon levels of siltation within behind dams. For example, restoration of meadows upstream may slow runoff during storms, thereby helping reduce flood danger and effectively storing water until the water can be used downstream. Thinning of trees can reduce evapotranspiration of water. Improved land management can reduce siltation behind reservoirs, thereby preserving usable storage volumes.

Source Control/ Salinity Control Measures

Raw water quality delivered to users can be improved either by shifting the location of the diversion or by reducing the concentration of pollutants at the existing intake and during conveyance to the water user. Reduction in the concentration of pollutants discharged upstream can be reduced through source control measures. Reduction in salinity intrusion can be reduced through increased outflow or various flow control structures. The Delta islands represent flow control structures in this sense. Loss of any of the Western islands would increase salinity intrusion.

Monitoring and Real-Time Operations

CALFED is increasingly focussing on the real-time management of entrainment at diversion points. The majority of the entrainment for individual species typically occurs during only a small number of days. If those days can be predicted in advance, diversions might be curtailed and entrainment dramatically reduced with a relatively low reduction on diversion levels. Greater diversions might then be allowed on days when entrainment is not a major issue. Monitoring is essential if real-time management of diversions is to be successful.

Diversion Relocation

Where real-time operations is based upon shifting diversions in time to avoid period when fish are near the pumps, diversion relocation moves the intake point in space to locations where diversions cause fewer problems. The spacial shift can be dramatic as with the isolated facility, or more subtle as with the proposal to move the SWP screens from the inside to the outside of Clifton Court Forebay (the idea being to create better conditions for screening and to reduce predation problems).

Similarly, diversion relocation could be used to improve the quality of raw water delivered to users.

Diversion Technology

As discussed, we may shift diversions in time and space to reduce diversion impacts. Another way to reduce diversion impacts is to improve the quality of screens. With better screens, diversions may take place as before, but with less impact.

Habitat Restoration

There may be a linkage between habitat restoration and required environmental flows. Historically, the ecosystem was able to sustain very major fluctuations in flows levels without damage. However, land and water development have reduced the resiliency of the ecosystem. It is possible, though unproven, that improvements in habitat conditions, as envisioned in the ERP might reduce environmental flow requirements, particularly in dry years.

Modified Operations

Individual operators of reservoirs and canals operate those facilities to maximize their own benefits. However, what is optimum from the perspective of a local agency is not necessarily optimum from a system perspective. To the extent that local project operators can be induced to reoperate their systems so as to promote system needs, greater supply and ecosystem benefits may be possible without new facilities. The San Joaquin River Agreement is an example of this type of reoperation. The San Joaquin Tributary Agencies agreed to release water on a more fish friendly schedule. The actual water cost to the agencies is small. For the most part, they are simply reoperating their reservoirs.

Markets

All of the tools discussed thus far represent physical or management changes, either at the user, operator, or ecosystem level. There has been little discussion about how those changes take place. One obvious way will be for various agencies to make them happen. The state and federal projects might be responsible for building new infrastructure, for example. Regulatory agencies might be responsible for managing real-time management.

However, in many cases the appropriate management tool will be through various forms of water markets. Rights to water, pumping, conveyance, and storage might all be exchanged in a market setting. The value attached to water might induce private actors to fund water conservation or to shift crops. Local project operations have already been modified as a result of market transactions. A market in habitat restoration has been created through the RFP process initiated by the Ecosystem Roundtable. At least one privately funded storage project, designed to produce water for sale in the market is near approval (Delta Wetlands). Environmental flows have already been purchased on the market and discussions are ongoing to define how the environmental might gain rights to existing and new storage.

Thus, markets are a tool with which to effect physical, operational, and biological changes desired by CALFED. However, numerous legal and infrastructure constraints exist which may limit the ability of markets to implement portions of the CALFED program.